Badalovite $NaNaMg(MgFe^{3+})(AsO_4)_3$

Crystal Data: Monoclinic. *Point Group*: 2/*m*. As obliquely terminated prismatic crystals to 5 mm, typically combined in sheaf-like clusters or crusts.

Physical Properties: *Cleavage*: None. *Tenacity*: Brittle. *Fracture*: Uneven. Hardness = ~3.5 D(meas.) = n.d. D(calc.) = 4.016

Optical Properties: Transparent. *Color*: Pale green to green, greenish gray to gray, bluish greenish, greenish yellow to bright yellow, honey-yellow, colorless. *Streak*: White to pale greenish or pale yellowish. *Luster*: Vitreous.
Optical Class: Biaxial (-). $\alpha = 1.753(3)$ $\beta = 1.757(3)$ $\gamma = 1.758(3)$ 2V(meas.) = 50(10)° 2V(calc.) = 53° *Dispersion*: Strong, $r > v$. *Orientation*: $Y = b$.

Cell Data: *Space Group*: $C2/c$. $a = 11.9034(3)$ $b = 12.7832(2)$ $c = 6.66340(16)$ $\beta = 112.523(3)°$ $Z = 4$

X-Ray Diffraction Pattern: Arsenatnaya fumarole, Tolbachik Volcano, Russia.
2.765 (100), 3.211 (46), 6.41 (38), 2.911 (28), 2.618 (26), 3.523 (25), 3.577 (23)

Chemistry:

	(1)	(2)		(1)	(2)
Na_2O	9.23	10.93	Fe_2O_3	12.77	14.08
K_2O	0.19		TiO_2	0.01	
CaO	2.04		SiO_2	0.06	
MgO	13.78	14.21	P_2O_5	0.33	
MnO	0.31		V_2O_5	0.05	
CuO	0.12		As_2O_5	61.51	60.78
ZnO	0.24		SO_3	0.02	
Al_2O_3	0.06		Total	100.72	100.00

(1) Arsenatnaya fumarole, Tolbachik Volcano, Kamchatka, Russia; average electron microprobe analysis supplemented by Raman spectroscopy; corresponds to $Na_{1.67}Ca_{0.20}K_{0.02}Mg_{1.92}Zn_{0.02}Mn_{0.02}Cu_{0.01}Fe^{3+}_{0.90}Al_{0.01}(As_{3.01}P_{0.03}Si_{0.01})_{\Sigma=3.05}O_{12}$. (2) $NaNaMg(MgFe^{3+})(AsO_4)_3$.

Mineral Group: Alluaudite supergroup, alluaudite group - arsenates.

Occurrence: A sublimate at an active volcanic fumarole.

Association: Hematite, tenorite, cassiterite, johillerite, nickenichite, calciojohillerite, bradaczekite, metathénardite, aphthitalite, langbeinite, calciolangbeinite, sanidine, fluorophlogopite, fluoborite, tilasite, anhydrite, pseudobrookite, sylvite, halite, lammerite, urusovite, ericlaxmanite, arsmirandite, svabite, krasheninnikovite, euchlorine, wulffite, alumoklyuchevskite.

Distribution: From the Arsenatnaya fumarole, Second scoria cone, Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik Volcano, Kamchatka, Russia.

Name: Honors mineralogist and geochemist Stepan Tigranovich *Badalov* (1919-2014), Abdullaev Institute of Geology and Geophysics, Uzbekistan Academy of Sciences, Tashkent.

Type Material: A.E. Fersman Mineralogical Museum, RAS, Moscow, Russia (95618).

References: (1) Pekov, I.E., N.N. Koshlyakova, A.A. Agakhanov, N.V. Zubkova, D.I. Belakovskiy, M.F. Vigasina, A.G. Turchkova, E.G. Sidorov, and D.Y. Pushcharovsky (2020) New arsenate minerals from the Arsenatnaya fumarole, Tolbachik volcano, Kamchatka, Russia. XIV. Badalovite, $NaNaMg(MgFe^{3+})(AsO_4)_3$, a member of the alluaudite group. Mineral. Mag., 84, 616-622.